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Fig. 1. Bronze weight from Ras Shamra-Ugarit, 14th-13th century B.C., inscribed with symbol for "20," and weighing 468.5 gm. The unit, 23.42 gm., is double the Palestinian shekel. (From *B. A.* II, 1 where it was reproduced by courtesy of the excavator, C. F. A. Schaeffer, and of the Editor and publishers of *Syria*.)

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Editors: G. Ernest Wright and Frank M. Cross, Jr., with the assistance of Floyd V. Filson in New Testament matters. Editorial correspondence should be sent to one of the above at 45 Francis Ave., Cambridge 38, Mass.

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Weights and Measures of The Bible

R. B. Y. Scott
Princeton University

How tall was Goliath, and how heavy was his armor? How large was Solomon's temple? Was the "acre" of which Isaiah speaks (5:10) the same as our acre, and what does he mean when he says "ten acres of vineyard shall yield but one bath?" What is a "Sabbath day's journey?" What is a "pim" (1 Sam. 13:21)? What quantity is represented by the "three measures" of meal in the Parable of the Leaven, and by the quite different "measures" of oil and wheat in the Parable of the Unjust Steward?

To ask such questions shows how necessary it is to the clear understanding of the Bible that we should know what such terms mean. At this distance in time it is not easy to be sure of all the answers. Very seldom in the Bible is one term of measurement defined in terms of another, as in Ezek. 45:11-12; even here we have stated only the ratios between units, and not the value of one from which the others can be calculated. Our information must come from the correlation of evidence from a variety of sources. There is first the *literary* evidence of the Bible, of extra-Biblical ancient works such as the Talmud, the treatise of Epiphanius on weights and measures (392 A.D.), incidental remarks of Herodotus, and especially the equating by Josephus of the Hebrew units with Graeco-Roman measures. Second, there is the *archaeological evidence* from Palestine and surrounding civilizations, the customs and cultures of which left their marks on ancient Israel.

In the first case we must ask how exact and reliable is the testimony of the literary sources. Second, we must allow for a difference between official and unofficial units, for debasement of standards and periodic revaluations, and for the fact that the same term might have had different values in contemporary metrological systems (like the American and British gallons

today). Indeed, many terms like *handbreadth*, *cubit* (forearm), *pace*, *bowshot* and *homer* (ass-load) were "natural" units of measurement, broadly indicating certain orders of magnitude, and persisting in common use after some of them had been standardized for purposes of commerce, taxation and architecture. The establishment of ratios between units which had been distinct in origin, whether "natural" terms or terms adopted from foreign metrological systems, must obviously have modified these in conforming them to a common standard.

It follows, then, that Biblical metrology is far from being an exact science because of the insufficiency and ambiguity of much of the evidence.

Fig. 2. A portion of a storage jar from Lachish, inscribed "Royal Bath" (from right to left, *bt lmlk*). From Olga Tufnell, *Lachish III. The Iron Age*, Pl. 49. Copyright: By permission of the Trustees of the late Sir Henry S. Wellcome, London.

The mensuration tables provided in works of reference must be used cautiously with this in mind. Nevertheless, a great deal of information can be gleaned from the material available.

I. Linear Measures

The *cubit* (Hebr. *'ammāh*, Lat. *cubitus*) is the principal unit of linear measurement in the Bible; it was common also to Egypt and Mesopotamia, and was assimilated by the later Greek and Roman metrical systems where the basic unit was the *foot*. Representing, as it did, the "natural" and always available means of measurement, a man's forearm, it must originally have come into use for the measurement of objects to which the forearm

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I. Linear Measures

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could be directly applied, such as the height of a man, the breadth of cloth or the thickness of a wall. Distances between points as distinct from measurements of the length of objects, were not expressed by large multiples of the cubit before the Exilic period, but rather by such expressions as "a bowshot" (Gen. 21:16), "a furrow's length" (1 Sam. 14:14), "a day's journey" (1 Kings 19:4; Lk. 2:44), "a three days' journey" (Gen. 30:36). The last appears to have been the usual expression for a considerable distance (cf. Gen. 30:36).

In Deut. 3:11 the "natural" cubit in common use is called "the cubit of a man." It would suffice to indicate broadly the size of an object such as the couch of Og, the flying scroll of Zech. 5:2, and Haman's gallows (Es. 7:14); and also the height of a man (1 Sam. 17:4; 1 Chron. 11:23), or an approximate depth (Gen. 7:20) or distance (John 21:8). But obviously a more precise unit would be required for the work of the architect, builder and craftsman; the vast majority of references to the cubit occur in the specifications of the Tabernacle and the Temple and their furnishings (Ex. 25-27; 36-38; 1 Kings 6-7; 2 Chron. 3-4; Ezek. 40-43). It is of interest and possibly of some importance to investigate the length of this standard cubit.

To begin with, we observe that two cubits differing in length are mentioned in the Old Testament, just as *we* have a land mile of 5280 ft. and a nautical mile of 6080 ft. Ezek. 40:5 specifies the use of a cubit which is a *handbreadth* or *palm* longer than the common cubit, i.e., consisting of seven palms rather than six. A longer and a shorter cubit, related in this ratio, were in use also in Egypt; in Mesopotamia the cubit of Khorsabad was 4/5 the length of the "royal" cubit first recorded on statues of Gudea of Lagash, and continuing in use until the time of Nebuchadnezzar II. From standard cubit rods which have survived and from corresponding architectural dimensions it is known that the two Egyptian cubits were about 20.65 in. and 17.6 in. long respectively, and the Mesopotamian "royal" cubit was about 19.8 in. Herodotus (*Hist.* i:178) refers to the last-named in his description of Babylon, and reckons it as "three fingers" longer than the (Egyptian?) cubit. There were 24 "fingers" in the Egyptian shorter cubit and 28 in the longer, so that the Babylonian "royal" cubit is in fact about three "fingers" longer than 17.6 in.

It would appear from Ezekiel's reference to two cubits related in the 6/7 ratio and from archaeological evidence that the Hebrew common cubit was only slightly shorter than the Egyptian common cubit. The Hebrew linear units followed the Egyptian pattern, though the name of the unit, *'ammāh*, is certainly related to Akkadian *ammatu*. The most definite piece of evidence we have as to the pre-exilic Hebrew cubit comes from the Siloam

inscription, which records the construction of Hezekiah's still existing water tunnel, and states that it was 1200 cubits long. This is a round number, and the points between which it was measured cannot be determined exactly. The most exact of the modern measurements, as given by Vincent, is 533.1 meters or 1749 ft., which yields a cubit of 17.49 in. If, on the other hand, we begin with a unit equivalent to the Egyptian common cubit of 17.7 in., the actual length of the tunnel becomes 1185 cubits, a close approximation to 1200 in view of the tunnel's serpentine course.

Fig. 3. Copy of a one-mina weight of Nebuchadrezzar II (605-562 B.C.) on the standard of Shulgi, king of Ur (*ca.* 2000 B.C.). British Museum, London. (From Pritchard, ed., *Ancient Near Eastern Pictures*, Princeton Univ. Press.)

Confirmatory evidence for a cubit of about 17.5 in. comes from a calculation from the dimensions in cubits of the "molten sea" of Solomon's temple (1 Kings 7:23-26; 2 Chron. 4:2, 5), coupled with its capacity reckoned in *baths*. A *bath* according to Albright's estimate equalled 22 liters =

5.8 U. S. gals.[1] Application of the formula for the capacity of a hemisphere ($2/3\ \pi\ r^3$) for 2000 *baths* gives a cubit of 22.06 in., a figure impossible to relate either to the cubit of the Siloam tunnel or to a seven-palm cubit of 20.4 in. If, however, Albright's figure is twice the correct figure of 11 liters (which is most unlikely), *or* if the ancient scribe used by mistake the formula for the capacity of a sphere instead of that of a hemisphere (which is quite possible), the capacity of 1000 baths = 22,000 liters corresponds to a cubit of 17.51 in.[2]

Although there is room for error in reported measurements of Israelite and pre-Israelite buildings excavated in Palestine, it is remarkable how many remains of large public buildings and enclosures can be measured in whole numbers of cubits of about 17.5 in., and even in *reeds* equivalent to *six* such cubits. A palace building in Stratum IV at Megiddo was evidently intended to be 50 cubits square. The southern stable compound measured 24 x 34 reeds, the courtyard was 20½ reeds square, and the length of the aisles 55 cubits. At Lachish the platform of the citadel was 12 reeds square and at Tell en-Nasbeh the base of the gate tower 5 reeds square. At Samaria a great round tower of early Hellenistic times was 33 cubits in diameter, with a circumference of approximately 100 cubits.

A test case for this method of calculating the length of the cubit can be made from Yadin's discovery of the remarkable similarities in plan and detail of the Solomonic city gates at Megiddo, Hazor and Gezer[3], to which G. Ernest Wright drew attention in *B.A.* XXI. 4. The similarities suggest to Yadin that the three structures were built from one plan by the same royal architect. One may go farther and suggest that the architect was Egyptian, since the measurements are in terms of the Egyptian common cubit of 17.7 in., 450-51 mm.,—slightly larger than the Palestinian unit which was derived from it. The length of the gate at Megiddo and Hazor is given as 20.3 m., or 45 cubits (7½ reeds) of 451 mm. The Gezer gate was 3 cubits or ½ reed shorter. The width of the gate is given as 17.5 m. at Megiddo and 18.0 m. at Hazor, or 39 and 40 cubits respectively. The width of the Gezer gate is 36 cubits or 6 reeds. In the smaller remaining dimensions there is greater room for error, but these, too, can be understood as measured in Egyptian cubits, *e.g.*, the casement wall of 5.4 m. is 12 cubits of 450 mm. in width.

The *reed* of six cubits (translated "rod" in Rev. 21:15 because there it is pictured as made of metal) was primarily an instrument for measuring

1. W. F. Albright, *Excavation of Tell Beit Mirsim, III, The Iron Age* (*Annual of the A.S.O.R.*, Vols. XXI-XXII), p. 58, note 7.

2. Cf. R. B. Y. Scott, "The Hebrew Cubit," *Journal of Biblical Literature*, Vol. LXXVII (1958), pp. 210-12.

3. Y. Yadin, "Solomon's City Wall and Gate at Gezer," *Israel Exploration Journal*, Vol. 8 (1958), pp. 80-86.

rather than a unit of measurement;[4] consequently greater lengths are given in multiples of cubits rather than of *reeds*.[5] The *span* or handstretch (*zereth*) was a "natural" unit only (cf. 1 Sam. 17:4; Exod. 28:16); an exact measurement was specified as a "half cubit," necessarily so because in some cases the shorter cubit of six handbreadths was in question (e.g. 1 Kings 7:31), and in other cases the "long" cubit of seven handbreadths (Ezek. 40:5, 42). The unique word *gōmedh* in Judg. 3:16 also may mean a span; the context makes clear that it is the length of a dagger rather than of a sword and cannot be a "cubit" as in EVV. At most it could be 2/3 cubit, or four handbreadths.[6] The smallest subdivision of the cubit, as in Egypt, was the *finger*, ¼ handbreadth (cf. Exod. 25:25, M. T. *ṭōphaḥ*, "handbreadth," Vulg. *quatuor digitis*, "four fingers").

The lineal measures of the Old Testament, based on a common cubit of 17.5 in., may be summarized as follows:

(common cubit)	1 *reed* (8 ft. 9 in.)	= 6 cubits
	1 *cubit* (17.5 in.)	= 6 handbreadths
	1 *handbreadth* (2.9 in.)	= 4 fingers
	1 *finger*	= .73 in.
(long cubit of Ezekiel)	1 *reed* (10 ft. 2.4 in.)	= 6 cubits
	1 *cubit* (20.4 in.)	= 7 handbreadths
	1 *handbreadth* (2.9 in.)	= 4 fingers
	1 *finger*	= .73 in.

A *span* is roughly ½ cubit, a *gōmedh* perhaps 2/3 cubit. The cubits mentioned in the New Testament are probably of the 17.5 in. standard, since the Romans reckoned the cubit as 1½ times the Roman foot of 11.66 in., or 17.49 in. Other Graeco-Roman units mentioned are the *fathom* or "arm-stretch" (Ac. 27:28), a "natural" unit equal to about 6 feet; the *stade* (Lk. 24:13; Jn. 6:19) 202½ yds. (1/8 Roman mile); and the Roman *mile* (Matt. 5:41), 1620 yds.

II. Measures of Area

Except in one instance, measurements of land area are given roughly in terms of what a "yoke" or team of oxen could plow in a day (1 Sam. 14:14; Isa. 5:10), or what would be sown with a specified amount of barley (Lev. 27:16; 1 Kings 18:32; Isa. 5:10). In Mesopotamia the former area was

4. Cf. Ezek. 40:5. The measurements of the city gates just referred to, however, suggest that the reed was exact enough to be used as a unit.

5. Cf. Gen. 6:15; Exod. 26:8; 1 Kings 6:2, etc.

6. Just as 2/3 shekel was called a "pim" and this name occurs only once in the Bible, so the "gomedh", may turn out to be 2/3 cubit.

defined as 6480 square cubits (or 20.4 in.) or about 4/10 acre. The Latin *jugum* ("yoke, team") was used similarly for the area plowed by a team, which was later defined as a *jugerum* of 28,800 square (Roman) feet, or 5/8 acre. A. Segre[7] gives evidence to show that 3 3/5 seahs were required to sow one jugerum of land in the Graeco-Roman period; if the seah was of the same standard as formerly, it would then = .173 acre, and a *homer* of 30 seahs would be 5.19 acres. From data in the Mishnah (using a 22 in. cubit) Benzinger[8] calculates that a seah was 784 sq. m., or .193 acre; at this rate a homer would be 5.79 acres.

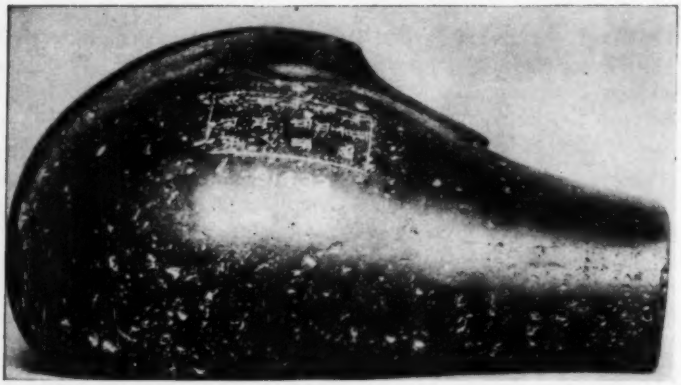

Fig. 4. Thirty-mina weight of Eriba-Marduk of Babylon (8th-7th century B.C.). British Museum, London. (From Pritchard, ed., *Ancient Near Eastern Pictures*, Princeton Univ. Press.)

The one example of a measured area in the Old Testament is the specification in Num. 35:4-5 of the size of the pasture lands of the levitical cities, and here the text is curiously ambiguous. Verse 4 says clearly that the lands are to extend outwards 1000 cubits from the city walls, but v. 5 seems to describe a square area with sides of 2000 cubits. Taken literally, this would leave no space for the city in the middle of the square. Either the writer has perpetrated an absurdity, or the 2000 cubits of v. 5, like the Egyptian "cubits of land" mentioned in the Rhind Mathematical Papyrus,[9]

7. A. Segré, "Ancient Palestinian Units of Measure," *Journal of Biblical Literature*, Vol. LXIV (1945) p. 372.

8. I. Benzinger, *Hebräische Archäologie*, 3 aufl., p. 192.

9. Cf. on the Egyptian "cubit of land" as a measure of area, A. E. Berriman, *Historical Metrology*, p. 70.

represent the frontage of the specified depth of 1000 cubits. In other words, the 2000 cubit square is not the area of the pasture lands, but a square enclosing the city and forming the frontage of the pastures on the city's four sides.

III. Measures of Capacity

Just as the linear measures, foot, cubit, span and fathom, were at first informally derived from the human body and its powers, so Hebrew units of capacity seem to be connected with the names and approximate capacities of household utensils and the farmer's estimates of quantities. The *hin* was a pot and the *ephah* probably a basket (both words of Egyptian origin); the *omer* was a sheaf and the *homer* a donkey load. *Bath* means "daughter"; one can speculate that it was about the capacity of the water jars carried from the well by the daughters of the household (cf. Gen. 24:15).

The standard liquid measures are the *bath* (Gk. *batos*, only Lk. 16:6 in N.T.), the *hīn* (1/6 bath), and the *lōg* (1/12 hīn). The lōg in Talmudic tradition was equal to 6 eggs. Ezek. 45:11 equates the liquid measure *bath* with the dry measure *ephah* by making each 1/10 homer, but the homer is simply named as a standard; it does not appear to have been used as a liquid measure.

The bath was formerly reckoned as 10.3 U. S. gals. (8.6 imperial gals.) from Josephus' equation of the lōg with the Greek *xestēs* and the Roman *sextarius*. Now, however, Palestinian archaeology has produced evidence that the bath was considerably smaller than this, something like U.S. 6 gals. (5 imper. gals.). Fragments of two large jars have been found, one at Tell ed-Duweir (Lachish) inscribed *bt lmlk*, "royal bath," and one at Tell Beit Mirsim inscribed simply *bt*. Unfortunately not enough of either jar was found to permit their reconstruction, and their original size has had to be estimated from unmarked jars apparently of similar shape and size. C. H. Inge[10] proposed a value of 45.3—46.6 litres (11.9—12.3 U. S. gals.) for the bath from the capacity of two reconstructed jars from Lachish, (one of which was inscribed "royal" but without naming a unit of measurement), assuming that these were the same size as the jar marked "royal bath." Inge does remark, however, that the latter seems to have been somewhat smaller, and W. F. Albright[11] is quite sure that, like the fragmentary jar from Tell Beit Mirsim marked simply *bt*, it was in fact only half the size of those with which Inge equated it. Hence Albright proposes about 22 litres

10. C. H. Inge, "A Postscriptum," *Palestine Exploration Quarterly* (1941), pp. 106-09.

11. See note 1.

(5. U. S. gals.) for the bath. Barrois' slightly larger figure[12] of 22.99 litres (6 gals.) is obtained by exactly halving the average capacity of the two large amphorae from which the calculations were made. Support for Albright's figure comes from the calculations of the capacity of the "molten sea" in Solomon's temple already mentioned in consideration of the cubit. A slightly depreciated bath of 21.5 litres is witnessed to by pottery of the Graeco-Roman period.[13]

It is difficult to say how the units of capacity of the Old Testament are to be related to those mentioned in the New Testament, the Greek *xestēs* (1 1/6 pints), *choinix* (c. 2 dry pints), *mētrētes* (10.2 U. S. gals.), and the Roman *modius* (¼ bushel). Standards varied in different areas at different periods, and were accomodated to foreign metrological systems. The Hebrew *bath* is translated in the Septuagint once by *mētrētes*, twice by *chous* which was 1/12 *mētrētes*, and three times in one verse by *kotulē* which was 1/12 *chous*. Josephus relates the Hebrew and Hellenistic systems so as to make the *bath* equal the *mētrētes*.[14] A still larger figure of about 12 U. S.

Fig. 5. Two-thirds mina weight of Shalmaneser V (726-722 B.C.). Bronze in the British Museum, London. (From Pritchard, ed., *Ancient Near Eastern Pictures*, Princeton Univ. Press.).

gals. has been deduced from a jar found at Qumran and marked "2 se'ah and 7 lōg." It seems that accomodation of the Hebrew to the Hellenistic system resulted, in some areas at least, in a marked enlargement of the ancient Hebrew units.

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12. G. A. Barrois, "Chronology, Metrology, etc.," *Interp. Bible*, Vol. I, p. 155.

13. Cf. R. P. Germer-Durand, "Measures de capacité des Hébreux au temps de l'Évangile," *Conf. de S.-Étienne*, (1910), pp. 91-105.

14. Cf. Fl. Josephus, *Ant. Jud.*, iii:8:3; viii:2:9.

The standard unit of dry measurement in the Old Testament was the *homer*, also called the *cor* through the assimilation of two systems. The homer seems to be used of amounts which could be visualized, i.e., as so many "ass loads," the largest number mentioned being 10. The cor, on the other hand, was a unit of account for very large quantities, as in 1 Kings 5:11 (Heb. 5:25). The Biblical units of dry measurement are arranged in what appears to be a combination of a Babylonian sexagesimal system and an (Assyrian?) decimal system:

1 homer) = 10 ephah = 100 omer or "tenths"
1 cor) = 30 seah or "thirds" = 180 kab

The *lethech*, mentioned only in Hos. 3:2, possibly a Phoenician measure, is interpreted by Aquila, Symmachus, Theodotion and the Vulgate as ½ cor.

In Ezek. 45:10 "a true ephah and a true bath" are equated and standardized by making each = 1/10 homer. Taking Albright's figure of 22 litres for the bath, the system of liquid and dry measures of capacity can be calculated as follows:

Liquid measures		(litres)	*Dry measures*			
(homer)	58.1 U. S. gals.	220	homer-cor	6¼	U. S.	bushels
		110	lethech	3 1/8	"	"
bath	5.8 U. S. gals.	22	ephah	3/5	"	"
		7.3	seah	1/5	"	"
hin	3.86 U. S. qts.	3.66				
		2.2	omer	4 U. S. dry pints		
		1.2	kab	2 2/9 dry pints		
log	2/3 liquid pint	.3				

It must be emphasized that the values given in the above table are tentative, for two reasons. In the first place, they are projected from Albright's figure of 22 litres for the bath, a computation made from estimated sizes of jars marked *bt* (from Tell Beit Mirsim) and *bt lmlk* (from Lachish) which were too fragmentary to be reconstructed. The supporting evidence from the calculated relationship of the bath to a cubit of 17.51 in. is hypothetical also. And in the second place, the ratios between the several terms in the table rest in some cases on post-Biblical evidence, and there is no certainty that these ratios were constant throughout the Biblical period, or were more than the defining of relationships which had earlier been only approximate. Only in Ex. 16:36 and Ezek. 45:11, 14 are any of these ratios defined (10 omer = ephah = bath = 1/10 homer), though the last ratio is implied also in Isa. 5:10. On the assumption that the ratios are correct, the values of the other units will vary proportionally with alternative values for the bath which have been proposed: *e.g.*, by Inge (45.3—46.6 litres), Galling and Nötscher (39.38 litres), Hultsch, Benzinger and Nowack (36.37—

36.44 litres), Lewy (24.12 litres), Barrois 1931 (39.38 litres), 1952 (22.99 litres), Germer-Durand (21.25 litres), Segré (Biblical period 20.92 litres, Hellenistic period 21.83 litres).

IV. Weights

When we turn to the problem of the weights mentioned in the Bible we find the archaeological evidence much more abundant than for the metrological units already considered. Inscribed and uninscribed stone weights representing the shekel and its fractions have been recovered intact in Palestine in considerable numbers. Unfortunately they do not give a consistent testimony. Larger weights representing the mina of 60 shekels and its fractions have come to light from different times in the long history of civilization in Mesopotamia, and it is quite clear that the Hebrew system is modelled on the Babylonian. The names of three of the four principal units are the same— *manū* = *māneh*, *shiqlu* = *shekel*, *girū* = *gērāh*, and the ratios of these to each other and to the largest unit, the "talent," are similar. This largest unit was known to the Babylonians as *biltu* and to the Hebrews as *kikkār*, "a round thing." The name "talent" comes from the Latin equivalent of the Greek *talanton*, "a weight, something weighed," which is of the same order of magnitude as the Babylonian *biltu* and may ultimately have been derived from it.

The Babylonian system was sexagesimal: 1 talent = 60 minas (to adopt for simplicity's sake the familiar names), 1 mina = 60 shekels, 1 shekel = 24 gerahs. There is evidence from Ugarit for a mina of 50 shekels, and the Biblical evidence indicates that a 50 shekel mina also was used in Israel, at any rate prior to Ezekiel. The archaeological evidence from inscribed Palestinian weights suggests further that in addition the mina of Palestine may have been reckoned at 50 to the talent, at least for a time. In order to clarify the obscurities it will be necessary to examine the data in some detail.

Two Biblical passages are of particular importance in the attempt to establish the ratios, though each is more ambiguous than it seems at first sight. Exod. 38:25-26 says that the sanctuary poll tax of a beka (or half shekel) a head paid by 603,550 men, amounted to 100 talents plus 1775 shekels; from this it is clear that (for the writers of the Priestly document of the Pentateuch, at least) there were 3000 shekels to the talent. This has usually been taken to mean 60 minas of 50 shekels, but it could equally well mean 50 minas of 60 shekels. The former seems more probable because sums of 50 shekels and upwards (e.g., 400, Gen. 23:15; 500, Ex. 30:24; 16,750, Num. 31:52; 2400, Ex. 38:29; 5000, 1 Sam. 17:5) always[15] are

15. The one exception, Num. 3:50, is a special case because it is a multiple of 273.

divisible by 50 but usually not by 60. Ezekiel, however, who redefines the cubit for the measurements of the sanctuary (40:5), and establishes a (new?) ratio between the bath, ephah and homer (45:11), in 45:12 seems to be redefining the mina as containing 60 shekels (20 + 25 + 15, Hebrew text and RSV margin). This is apparently why the shekel is said to be 20 gerahs; there were 24 girū in a Babylonian shekel, and 20 x 60 = 24 x 50 = 1200 gerahs. It is reasonable to suppose that the shekel is thus being revalued without changing the value of the mina. The supposition may throw light on the otherwise puzzling phenomenon of the discovery, along with stone weights indicating a shekel of a little under 12 gm., of a second series marked *n-ṣ-p* which is roughly 5/6 the weight of the first series.

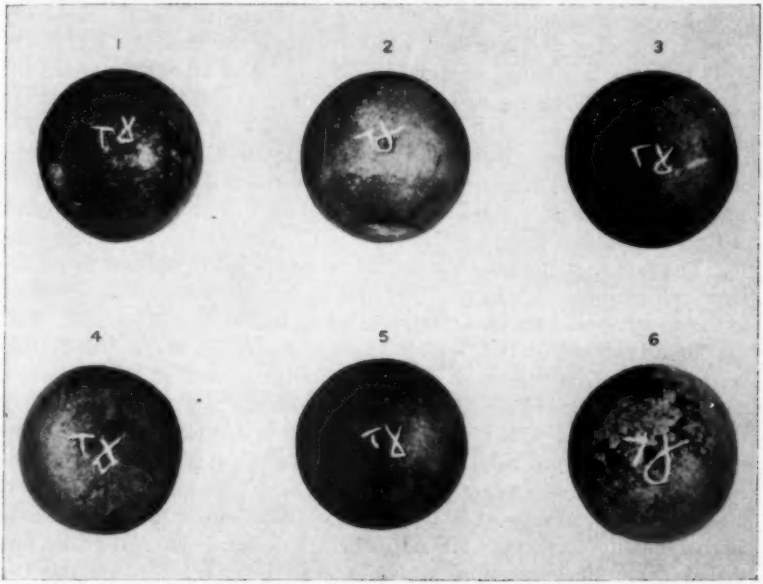

Fig. 6. Weights of eight shekels found at Lachish. The looped symbol of the shekel may represent the tied bundle in which silver was kept. Since these weights all are in the vicinity of 91 gm. (3 1/5 oz.), the mark to the left of the shekel sign must represent "8". From Olga Tufnell, *Lachish III. The Iron Age*, Pl. 51. Copyright: By permission of the Trustees of the late Sir Henry S. Wellcome, London.

Before turning to the data provided by actual weights recovered from ancient Palestine and Mesopotamia, three other pieces of evidence in the Old Testament may be noted for what they are worth. In Gen. 23:16 the price which Abraham paid for the field of Machpelah is paid in "shekels of silver current with the merchant," possibly to distinguish this weight from

"the shekel of the sanctuary" of 20 gerahs (cf. Exod. 30:13). This distinction may explain why the temple tax is said in Neh. 10:32 (Heb. 10.33) to have been 1/3 shekel, whereas according to the legislation in Exod. 38:26 it is a beka or ½ shekel; the difference of 2 gerahs, 1/12 the common shekel and 1/10 the sacred shekel, is negligible. The third item is the definition in 2 Sam. 14:26 of shekels by the standard of "the king's stone-weight." This shows that as early as the time of David an official standard existed and could be referred to.

In establishing such a royal standard David was following the ancient practice of kings. A copy of a stone weight of one mina made by Nebuchadnezzar II (605-562 B. C.) is certified to be according to the standard established by Shulgi, king of Ur (*c.* 2000 B. C.). It weighs 978 gm., which gives a corresponding talent of 58.68 kgm. A bronze weight artistically representing a lion and inscribed with the name of Shalmaneser V (727-722 B. C.) weighs 2/3 mina, yielding a talent of 59.82 kgm. These are the "heavy" or double talents and minas, for there is a second series bearing the same names of the units but with half their values. A two talent weight of Urningursu of Lagash gives a talent of 30.27 kgm. Two weights of Shulgi of Ur show minas of 496 and 498.6 gm., and hence a talent of 29.76—29.91 kgm. A weight of 30 minas in the shape of a duck or swan from the palace of Eriba-Marduk of Babylon (7th cent. B. C.) yields a talent of 30.18 kgm.

The fact that the same figure "30 talents of gold" appears as part of Hezekiah's tribute in 1 Kings 18:14 and in Sennacherib's annals [16] points to the acceptance of the same standard talent in Judah as in Assyria. That the "light" rather than the "heavy" talent and mina are in question quickly becomes clear from the small stone weights in terms of the shekel which have come to light in Palestine. Larger weights are rare; one found at Tell Beit Mirsim weighs 4565 gm. A little exercise in arithmetic quickly shows that the values of this weight which can yield a talent of about 30 kgm. are (i) 10 minas at 60 to a talent of 27.39 kgm., (ii) 9 minas at 60 to a talent of 30.43 kgm., (iii) 8 minas at 50 to a talent of 28.53 kgm. and (iv) 7 minas at 50 to a talent of 32.6 kgm. When, further, these figures are subdivided into shekels (a) at 60 to the mina and (b) at 50 to the mina, there are only two possible conclusions: this weight is *either* 9 Babylonian minas of 507.2 gm., (9 x 60 shekels of 8.4 gm., and 9/60 talent of 30.43 kgm.) *or* it is 8 Hebrew minas of 570.6 gm., (8 x 50 shekels of 11.41 gm., and 8/50 talent of 28.53 kgm.).

Two points favor the second alternative. The first is the obvious one that its provenance is an Israelite city. The second is its shekel of 11.41 gm.

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16. Cf. J. B. Pritchard, *Ancient Near Eastern Texts*, p. 288.

which corresponds to the 11.39 gm. average of fifteen weights from Palestine inscribed with the shekel sign. Even if the two other abnormally large shekel weights are included, the average weight of 11.53 gm. is not very different. This leads to an important conclusion, viz., that the Hebrew governmental and commercial system in contrast to the Babylonian was *quinquagesimal* rather than sexagesimal; 1 talent = 50 minas = 2500 shekels. In introducing a shekel smaller by 1/6 (20 gerahs for 24 gerahs), Ezekiel, as already noted, provides for a mina of 60 shekels and a talent of 3000 shekels, and is followed in this by the Priestly document.

At this point we must turn to the evidence provided by the few large and many small weights from ancient Palestine which have come to light.[17] Some of these are inscribed with the names of the units involved, and others with symbols which must be interpreted. Many more do not have inscriptions, but can be taken into account if they fall within the ranges of those which do. In seeking to pin down the value of the shekel weight (while recognizing the variables of time and place) we must begin with the *beka* or half shekel. This is because the *beka* is the only weight, the name of which appears both in the Old Testament and on recovered weights, *and* relationship of which to the shekel is given (cf. Exod. 38:26). The *pim* fulfils one condition and the *gerah* fulfils the other, but only the beka fulfils both.

Seven stone weights inscribed *b-q-'* have been found, ranging from 5.8 to 6.65 gm., and averaging 6.04 gm. To these may be added five uninscribed weights which fall within the same range and must represent the beka. The over all average of the twelve is 6.02 gm. Hence the shekel *if reckoned from beka weights* is 12.02 gm.[18]

The qualification is necessary since ancient scales were not precision instruments[19] and any error in a small weight is compounded by multiplying it. A beka of 6.02 gm. is equivalent only to about 1/5 oz. The important thing is that the beka weights show that the shekel weighed something like 12 gm. or 2/5 oz., and therefore that the symbol resembling a "figure 8" with an open loop found on weights of about 12 gm. is the shekel mark. Actually, this figure is too large, as becomes evident when the evidence from heavier weights representing multiples of the shekel is analysed. The

17. To avoid proliferation of footnotes, let it be said that the figures are drawn from one or more of the following: D. Diringer, *Le Iscrizioni Antico-ebraiche Palestinesi*, 1934; S. Moscati, *L'Epigrafia Ebraica Antica, 1935-1950*, 1951; R. A. S. Macalister, *The Excavation of Gezer, II*, 1912; O. R. Sellers, *The Citadel of Beth-Zur*, 1933; R. S. Lamon and G. M. Shipton, *Megiddo I*, 1939; W. F. Albright, *Excavation of Tell Beit Mirsim, III, The Iron Age*, 1941-43; C. C. McCown, Tell en-Nasbeh, 1947; O. Tufnell, M. A. Murray and D. Diringer, *Lachish III, The Iron Age*, 1953; J. B. Pritchard, *Hebrew Inscriptions and Stamps from Gibeon*, 1959.

18. The divergence of these figures from those given in the table below is due to the omission in the table of one of the seven beka weights because it is ½ larger than the average of the other six, and appears to belong with the Gezer and el-Jib shekels of 12.89 gm. (shekel iii).

19. Diringer, *Palestine Exploration Quarterly*, 1942, p. 86, notes a margin of error up to 6% in ancient balances tested.

large unmarked weight from Tell Beit Mirsim already referred to as probably equal to 8 minas gives a shekel of 11.41 gm., and from the seventeen weights bearing the shekel mark in units and multiples the average figure which comes out for the unit is 11.53 gm. The shekel symbol, incidentally, seems to be a conventional representation of the *ṣerōr* or tied bundle in which lump silver (used as a medium of exchange) was carried.

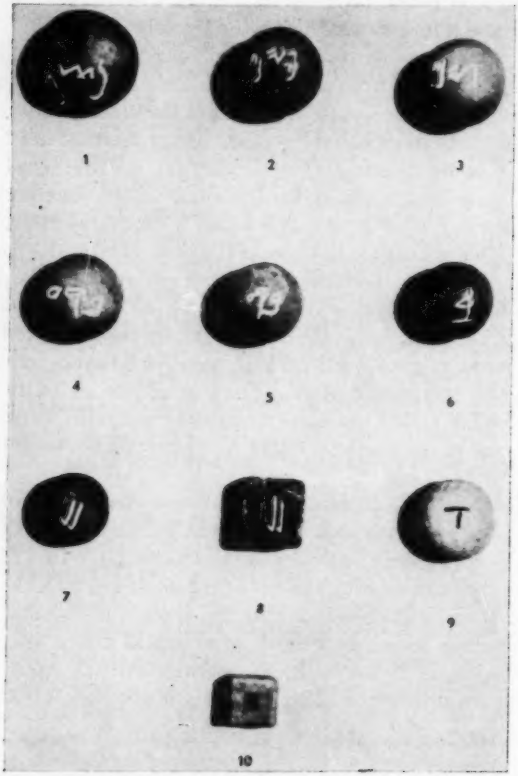

Fig. 7. Weights representing fractions of a shekel, from Lachish. No. 1 inscribed *n-s-p* (5/6 common shekel). Nos. 2-3 inscribed *pym* (2/3 shekel). Nos. 4-5 inscribed *bq'* (½ shekel). No. 6 inscribed *b*, for *bq'* (beka). Nos. 7-8, sign for 2/6 shekel. No. 9, obscure. No. 10, sign for 2/12 *n-s-p* shekel From Olga Tufnell, *Lachish III. The Iron Age*, Pl. 51. Copyright: By permission of the Trustees of the late Sir Henry Wellcome, London.

In order to obtain greater precision as to the weight of the Israelite shekel, the evidence of a large number of published weights from ancient Palestine is analysed in the following tables. The first table includes weights

which represent the shekel and its multiples. The second table sets out the data provided by small weights which can be considered as fractions of a shekel, where the margin of error is likely to be greater. Uninscribed weights which are close to the range of the fewer inscribed weights are included because their intended value seems clear, and they considerably enlarge the available evidence. Because of the tendency of metrological units to depreciate with the passing of time we must assume that the shekel standard was near the upper limit of the range of the examples recovered, i.e., somewhere between the average and the upper limit. Consequently, in addition to the *average* of the several weights, the *mid-point between this and the upper limit* is given as possibly a closer approximation to the intended value. At the same time there is the possibility that the largest examples are in error, or represent the slightly larger shekel of a neighboring country.

Table A. *Weights of a shekel and upwards*

multiple	x 1	x 2	x 4	x 8	x 16
(Inscribed)	2	3	3	9	—
no. of examples					
range in gm.					
as shekels	11.3–11.37	11.14–12.25	11.15–11.5	11.08–11.85	—
average	11.34	11.54	11.35	11.42	—
mid-point	11.34	11.84	11.42	11.63	—
(uninscribed)					
no. of examples	10	11	15	12	3
range in gm.					
as shekels	11.23-12.15	11.2-11.69	11.04-12.	10.98-11.5	11.25-11.36
average	11.5	11.32	11.45	11.22	11.31
mid-point	11.82	11.5	11.72	11.39	11.34
Totals					
no. of examples	12	14	18	21	3
range in gm.					
as shekels	11.23-12.15	11.14-12.25	11.04-12.	10.98-11.85	11.25-11.36
average	11.47	11.37	11.43	11.31	11.31
mid-point	11.74	11.81	11.71	11.58	11.34

Average of the averages— 11.38 gm.

Average of the mid-points— 11.63 gm.

Table B. *Weights of Fractions of a Shekel*

Fraction	5/6	2/3	1/2	2/5	1/3
(Inscribed)	(n-ṣ-p)	(pim)	(beka)		
no. of examples	13	7	6	1	none
range in gm.	9.28–10.51	7.18–8.13	5.66–6.15	4.87	—
average	9.86	7.56	5.94	4.87	—
mid-point	10.18	7.84	6.04	—	—
range as shekels	11.13–12.61	10.77-12.19	11.32-12.30	12.17	—
average as shekels	11.83	11.34	11.88	12.17	—
mid-point as shekels	12.21	11.76	12.08	—	—
(uninscribed)					
no. of examples	10	3	6	3	10
range in gm.	9.14–10.5	7.3–7.65	5.28-6.2	4.58-4.76	3.55–4.02
average	9.79	7.51	5.86	4.69	3.78
mid-point	10.14	7.58	6.03	4.72	3.9
range as shekels	10.96-12.6	10.95-11.47	10.56-12.40	11.45-11.9	10.65-12.06
average as shekels	11.75	11.26	11.72	11.72	11.34
mid-point as shekels	12.15	11.37	12.06	11.8	11.7

A weight of 2.49 gm. from Sebastiyeh, inscribed "*ḥ-m-sh*," probably represents 5 gerahs, as another weight of the same provenance of 2.54 gm. is inscribed "¼ n-ṣ-p, ¼ s-(q)-1." This tends to confirm the hypothesis that the *n-ṣ-p* is the shekel of Ezekiel of 20 gerahs. Another weight of 2.63 gm. is marked "4th part of a shekel" (i.e., of a n-ṣ-p shekel), and two others not inscribed are of comparable size, 2.62 and 2.8 gm. respectively (cf. 1 Sam. 9:8).

Some additional weights have been excluded from the above tables because they fall too far above the normal ranges. These in fact suggest a different system with a slightly larger shekel of about 13 gm., perhaps used for weighing a special commodity. De Langhe[20] notes that at Ugarit two words—*t-q-l* and *k-b-d*—were used for the shekel, the "heavy" shekel being

20. R. de Langhe, *Texles de Ras Shamra, II*, pp. 410 ff.

used in weighing purple linen. At el-Jib Pritchard found a weight of 51.58 gm. inscribed with the same signs for "4 shekels" as were recorded long ago by Guthe and Bliss-Macalister on weights of 44.6, 45.6 and 46 gm.[21] The el-Jib weight, however, yields a heavier shekel of 12.89 gm., and other data support this. From Gezer came a weight marked with five vertical (?) strokes and weighing 64.47 gm., which is almost exactly 5 x 12.89 gm. Three uninscribed weights from Gezer average 64.83 gm., or 5 x 12.96 gm. Three other unmarked weights average 51.28 gm., or 4 x 12.82 gm. A *pim* of 8.59 gm. is 2/3 a shekel of 12.88 (Tell en-Nasbeh). From Megiddo comes a weight of 13.4 gm., and from Tell en-Nasbeh two more of 13.3 gm. With the latter may be compared a beka of 6.65 gm. recorded by Diringer.

The conclusions to be drawn from this analysis of the archaeological evidence are less definite than could be desired. Many variables must be allowed for—the tendency to depreciation of standards with the passing of time; revaluations by official act; variation between official and unofficial measures; the use of different standards in weighing different types of goods; the influence of foreign metrological systems which approximated but were not identical with Israel's. Finally, not all examples come from controlled archaeological contexts, and all may not have been cleaned and weighed with equal care.

Nevertheless the data point toward certain tentative conclusions. For one thing, it appears that the larger the weight, the smaller is the shekel unit derived from it. The larger weights, broadly speaking, may be better sources of information because they give less opportunity for small errors to be compounded through multiplication. Most, but not all, the weights in fractions of a shekel yield when multiplied a shekel well above the average.

There seem to have been *three* standards for the shekel: (1) a temple shekel or *n-s-p* of about 10 gm. (.351 oz.) which depreciated to about 9.8 gm. (.345 oz.);
(2) the common shekel, originally of about 11.7 gm. (.408 oz.), which depreciated to about 11.4 gm. (.401 oz.); and
(3) a "heavy" shekel of about 13 gm. (.457 oz.).

To return to the queries with which this article began. How tall was Goliath? Six cubits and a span, 9 ft. 5¾ in. (if the measurement was exact!); probably a rough approximation "by the cubit of a man" was all that was intended. How heavy was Goliath's armor? His coat of mail weighed, we are told, 5000 shekels of bronze; that would be 100 minas, or about 125 lbs. avoirdupois. How large was Solomon's temple? It was 60

21. Cf. *Zeitschrift des Deutschen Palästina-Vereins* 1882, Pl. 10; F. J. Bliss and R. A. S. Macalister, *Explorations in Palestine*, 1902, p. 145.

cubits long, 20 cubits wide, and 30 cubits high, i.e., 87 ft. 6 in long, 29 ft. 2 in. wide, 43 ft. 9 in. high (quite a small structure!).

The "acre" of which Isaiah speaks in 5:10 was what a team of oxen could plow in a day, roughly half an acre by our standard. The yield of one *bath* of wine from 10 acres of vineyard would be about 5.8 U. S. gals. A "sabbath day's journey" (Acts 1:12) was the distance permissible for Sabbath travel; according to a rabbinical rule derived from Num. 35:5 this was 2000 cubits, 972 yds., or a little over half a mile. A *pim*, as we have seen, was the name for 2/3 shekel weight, or a little more than ¼ oz. The "three measures" of meal in the Parable of the Leaven (Matt. 13:33) were *sata* (Greek) or *seahs* (Hebrew), also called "thirds" because three of them equalled an *ephah*. about 3/5 U. S. bushel. In the Parable of the Unjust Steward, on the other hand, the "hundred measures of oil "were *baths*, and the "hundred measures of wheat" were *cors*. The quantities, therefore, are of the order of 580 U. S. standard gallons of oil, and 625 U. S. bushels of wheat.

The Nabataean Bitumen Industry At The Dead Sea

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The Dead Sea was one of the major sources of commercial bitumen in the ancient Near East.[1]

Diodorus Siculus[2] states that the Nabataeans controlled the Dead Sea bitumen industry in the Graeco-Roman period.

The role of the Nabataeans in this extremely lucrative, commercial enterprise has hitherto been ignored.

Yet, if Diodorus' statement is correct, the Nabataeans had a monopoly over this industry and Egypt was the primary market.

It is, therefore, necessary to determine the accuracy of Diodorus in relation to three aspects:

1. The fact of monopolistic control of the industry by the Nabataeans.
2. The precise nature of the industry itself.
3. The fact and the nature of the market.

In both references which bear upon this problem, Diodorus identifies the control of this Dead Sea source of revenue with the Nabataeans specifically. They are referred to as "Arabs," "barbarians," and "natives," as

1. J. L. Kelso and Alfred R. Powell, "Glance Pitch From Tell Beit Mirsim," *Bulletin of The American Schools of Oriental Research*, No. 95 (Oct., 1944), p. 15. Frederick J. Clapp, "Geology and Bitumens of The Dead Sea Area, Palestine and Transjordan," *Bulletin of The American Association of Petroleum Geologists*, Vol. 20, No. 7 (July, 1936), p. 901. R. J. Forbes, *Studies In Ancient Technology*, Vol. I, pp. 30, 53 and *Bitumen and Petroleum In Antiquity*, pp. 17-18.

2. Diodorus, II, 48 and XIX, 98-99, 100.

well as, properly, "Nabataeans." In view of known boundaries of Natatene in this area the accuracy of Diodorus on the point of control is unquestionable. The statement of Diodorus is likewise clear that the Dead Sea is situated in the land of the Nabataeans—hence they enjoy the monopoly and defend it against encroachment.[3] This assertion of control over the area, including even Jericho, is made elsewhere in ancient writers.[4] Reference to the problems arising here is made at length by Josephus in his description of the conflict between Herod, Cleopatra, and the "Arabians." The last mentioned neglected their taxes (imposed upon them when part of their lands were "granted" to Cleopatra by Anthony), and greatly embarassed Herod, since he had agreed to function as the collector!

The Nabataeans represent, then, the sole sellers in a market of limited competition, and hence, a monopoly.

The exact nature of the industry involved is not a matter of dispute. The fact that the Dead Sea was, and still is, a source of marketable bitumen is attested in both ancient and modern sources.

The specific product of the Dead Sea is true bitumen, as chemical analysis shows. This justifies the classical references to "asphalt," and the application of the name "*asphaltic lake*" (*Asphaltitidos*, or *lacus asphaltites*) to the Dead Sea.[5] Diodorus was thus completely accurate when he used the precise classical term for bitumen (i.e. *asphaltos*,) in its native state (the "plastic" type of Pliny, called by some modern writers "glance pitch"[6]). Another term was commonly employed to designate compounds or rock asphalts (i.e. *pittasphaltos*). The bitumen from the Dead Sea eventually took on geographical identity as well, and became known as "Jews' pitch."[7] Lynch refers to it as "Moses' Stone (*hajar mousa*)," but in error.[8]

The appearance of bitumen in the Dead Sea is recorded by Diodorus in detail. It is said to spring forth from the center of the sea as a solid mass, preceded by an odor twenty days in advance of its release to the surface. This mass floats on the surface, and is chopped up into workable size with axes and loaded into boats.[9]

The quantity which rose to the surface at one time is also recorded in Diodorus and in modern authors as well. The former asserts that the lake produces asphalt, from which "not a little" revenue is derived by the ex-

3. *Idem*, XIX, 100 and cf. XIX, 95, 97.

4. *Idem.*, II, 48; XIX, 97, 99, 100; Josephus, *Antiquities*, XV, iv, v, vi.

5. Diodorus, II, 48 and XIX, 98-99; Forbes, *op. cit.*, p. 22; Forbes *Studies. . . .*, pp. 3 ff. for general discussion and technical definitions of bituminous types; Josephus, *op. cit.*, I, x and XV, ix; *Contra Apion*, I; *Wars*, V, iii, iv, v; XII, xxv, xxviii; XVII, viii. Clapp, *op. cit.*, p. 902 (99.04% bitumen); Forbes, *Studies . . .*, p. 65 (Table V—98%); cf. also—*Tabul. Peut.*, Seg. X, 1.

6. Kelso and Powell, *op. cit.*, pp. 15-16 (and note 13—citing Pliny, *Nat. Hist.*, XXV, 51 and VII, 15).

7. Forbes, *op. cit.*, p. 22; Thomas Joseph Pettigrew, *A History of Egyptian Mummies . . .*, p. 79.

8. W. F. Lynch, *Narrative of The United States' Expedition To The River Jordan and The Dead Sea*, p. 304

9. Diodorus, XIX, 98, 99.

ploiters. The area of the floating mass is described as sometimes more than 300 feet in extent.[10] Other ancient writers mention bitumen floating on the Dead Sea.[11] In more modern times similar descriptions of masses of bituminous materials are recorded, especially on the Eastern shores.[12] This latter fact is significant, since that shore was nearest to the main area of the Nabataeans.

Hence it may be concluded that Diodorus is correct here again in reference to the quantity of bitumen present; and thus the extent of the industry in the first century B. C. was indeed of some importance financially.

It is the question of the market, its nature and extent, as reported by Diodorus, which, however, causes major problems.

Diodorus states[13] that the Nabataeans took the asphalt to Egypt and sold it

> "for the embalming of the dead; for unless this is mixed with the other aromatic ingredients, the preservation of the bodies cannot be permanent."

Issue has been taken with this statement of Diodorus—and hence with the veracity of his entire report of the industry and thus with the importance of the Nabataean monopoly of it.

The point of dispute lies in the reference to bitumen as an ingredient in Egyptian embalming. Denial of the use of bitumen has brought denial of the accuracy of the statement as a whole.

A number of writers, ancient and modern, have discussed the embalming methods of the Egyptians. Basic among ancient sources are the descriptions of Herodotus[14], Strabo, and Diodorus[15] himself. The former makes no reference to the use of bitumen, although he appears to survey the general technique in detail. Diodorus reflects a similar opinion in his description of the process, but, as is shown above, makes bitumen a basic ingredient in his reference to the Dead Sea industry. Strabo likewise makes bitumen a part of the process.

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10. *Idem.*, II, 48 ("plethera").

11. Forbes, *op. cit.*, pp. 29 ff., citing Pliny, *Nat. Hist.*, XXXV, 178, Strabo, *Geog.*, XVI, 763; and pp. 45-6, citing Tacitus, *Hist.*, V, 6—where Diodorus' description of the industry is supported.

12. Forbes, *Bitumen . . .*, p. 17; Clapp, *op. cit.*, p. 901—reporting weights up to 100 lbs.; also see p. 900 and especially p. 903 (photograph of floating mass); Eugene Hoade, *East of The Jordan*, p. 8; Lynch, *op. cit.*, pp. 297, 303, 306, 307. Thomas Wright, *Early Travels In Palestine*, p. 178 (Sir John Maundeville) and p. 453 (Henry Maundrell). Geologic disturbances may account for curtailment of quantity since the 1st Century B.C.—A.D.

13. Diodorus, XIX, 99 (Loeb text); A. Lucas, "The Question of The Use of Bitumen or Pitch By The Ancient Egyptians In Mummification," *The Journal of Egyptian Archaeology*, Vol. 1 (1914), pp. 241 ff.

14. Herodotus, II, 85-88.

15. Diodorus I, 91; Warren R. Dawson, "Mummy," *Encyclopaedia Britannica* (1936), Vol. 15, p. 955; Strabo, XVI, ii; Forbes, *op. cit.*, p. 93.

The technical expert, A. Lucas, has been the major figure in the bitumen controversy, and is generally cited as denying the presence of that substance in mummified remains. He, himself, has discussed the question at length. He has suggested that "possibly the general idea that bitumen or pitch was frequently used may be erroneous"[16] and that much material so described may actually be something else[17]. Warren R. Dawson[18] has put forward a similar view, pointing out that what may appear to have the luster of bitumen may be simply resin[19].

Lucas concludes that the entire problem could be solved best by means of a chemical analysis of mummified remains. He analyzed some 26 samples (solubility tests), but could find no traces of mineral pitch present[20].

The conclusion of Lucas is, therefore, *not* a denial of the use of bitumen or pitch in the mummification process, but rather a cautious statement to the effect that it is unsafe to describe any preservative as bitumen that merely looks like it.[21] Thus Lucas cannot be cited as stating that *no* bitumen was employed in the Egyptian embalming process.

On the other hand, there is positive evidence to support the statement of Diodorus in regard to the Egyptian market.

There is, first of all, supplemental evidence from classical and post-classical sources to corroborate his *general* statement. Strabo, Pliny, Josephus, and Tacitus all confirm him in regard to the fact of the industry, the importance of the area and the matter of its control.[22]

Relevant to the question of the Egyptian market there is, of course, the possibility of other uses, aside from embalming, which the Dead Sea industry might have served. There are a variety of purposes to which bitumen was put in the ancient world. The most obvious use was water-

16. Lucas, *op. cit.*, p. 241 and note 61, and citing himself in Report, 1907-08, *Arch. Survey of Nubia*, Vol. II, Cairo, 1910.

17. *Idem.*, p. 243.

18. Dawson, *op. cit.*, p. 955; Cf. W. A. Schmidt, "Chemische und biologische Untersuchungen. . . . ", *Zeit. für Allgemeine Physiologie*, VII (1908), pp. 389, 392—that climate, not method, preserved the bodies—but this is no valid objection to Diodorus, since the mechanics were unknown to the ancients, as their practice indicates.

19. Dawson, *op. cit.*, p. 955—where Dawson apparently saw only the objections of Lucas; see also, "Making A Mummy," *The Journal of Egyptian Archaeology*, Vol. XIII (1927), p. 49.

20. Lucas, *op. cit.*, pp. 243-45—where 19 cases failed to be conclusively bituminous, but the report is not adequate. See E. A. Wallis Budge, *The Mummy*, p. 201 (the compound—"pissasphaltos").

21. Lucas, *op. cit.*, p. 245.

22. Strabo, XVI, ii; Tacitus, V, 6; Pliny, XXXV, 178; Josephus, *Antiq.* I, x and (more relevantly) XV iv, v, vi; Forbes, *op. cit.*, notes most classical sources, pp. 15-18; also Diodorus, XIX, 97-100.

proofing for coffins and other articles among the Egyptians.[23] Allied to this is the use of bitumen as a cement or binding agent. This was common in antiquity[24] as a means of joining parts,[25] or for tacking.[26] The use of bitumen in fine inlay work and in gilding is not noted in Egypt, but both uses are at least possible there.[27] The Egyptians also employed the substance for the manufacture of imitation gems,[28] and in the coloring and production of metals.[29] Bituminous masks for the preservation of mummy faces are cited by Maspero,[30] but are apparently uncommon. In the realm of ritual "preservation" of mummies, scarabaei[31] and amulets[32] of bitumen served to repel enemies from the tomb itself. Perhaps of similar intent was the use of bitumen to obliterate the decorations on cartonage cases,[33] and in cavities behind the mummy.[34] The use of bitumen as a base for, or an ingredient in, paints and varnishes apparently was not an Egyptian technique. Both Lucas and Forbes deny the presence of "bituminous" lacquers there.[35]

Ultimately, however, the veracity of Diodorus in regard to the market —and thus the importance of the industry—rests upon whether or not bitumen was actually used by the Egyptian embalmers, to whom he assigns the use of the Dead Sea product.[36]

Here the evidence is varied and from an array of sources. Strabo, it has already been noted, agrees with Diodorus that bitumen was employed in the Egyptian embalming process.[37] This was also the view of Ibn el-

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23. Forbes, *op. cit.*, pp. 67 ff, 85 ff.—especially p. 89—citing W. D. Van Wijngaarden's *Het Egyptische Mummieportret*, p. 16; the possibility of this use extending to the tanks, etc. of the embalmers has not yet been explored fully.

24. *Idem.*, pp. 87, 89-91; Kelso and Powell, *op. cit.*, p. 17.

25. Forbes, *op. cit.*, p. 89.

26. I. e. papyri to mummies—so Pettigrew, *op. cit.*, p. 135, citing Belzoni.

27. Cf. Forbes, *op. cit.*, p. 80 and note Josephus' mention of the gilding cement used in the Temple of Herod, *Antiq.* XVII, xii; see also Pettigrew, *op. cit.*, pp. 63 ff.

28. Forbes, *op. cit.*, pp. 87-88.

29. *Idem.*, p. 87.

30. G. Maspero, *History of Egypt*, Vol. VI, p. 8.

31. Pettigrew, *op. cit.*, p. 107.

32. Budge, *op. cit.*, p. 353, citing *The Book of The Dead.*

33. *Idem.*, p. 222—to preclude identification? (Case BM 20744).

34. Pettigrew, *op. cit.*, p. 73 (Case No. 107, Catalogue of Antiquities of Baron Devon).

35. Kelso and Powell, *op. cit.*, pp. 17-18; and Forbes, *op. cit.*, p. 82, although common elsewhere (e.g. Babylon); pp. 79 ff., 39; *Studies . . .* , pp. 88-89.

36. Diodorus XIX, 99.

37. Strabo, XVI, ii.

Beitar in his discussion of the drug later derived from mummies.[38] Pettigrew refers to mummies embalmed with bituminous materials,[39] and cites discussion in regard to the analysis of specimens.[40] George Reisner and Wood Jones are said to have found mummies prepared with bitumen.[41] Spielman reported the presence of bitumen in mummies examined by spectrographic means, but in low percentage.[42] Budge mentions a "very large number" of bodies mummified, in the later dynasties, simply by dipping them in bitumen.[43] He calls attention to the hardness, color, brittle nature, and burning qualities of such remains,[44] but without a complete analysis. Medical examiners have likewise reported finding bitumen, or bituminous materials, in mummies. The most common occurrence reported is the use of this material in the preservation of the viscera,[45] but it is also reported as a filling for the abdominal cavity,[46] or the skull[47], or other orifice.[48]

Bitumen is also said, in a few cases, to have been found on the mummy bandages, either as a result of absorption or intentional saturation.[49]

That fewer cases of mummies prepared with bitumen are reported may reflect either loss of bodies through later depredation (e.g. treasure hunters, or drug merchants), or disintegration of the bodies from poor initial prepa-

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38. So Forbes, *op. cit.*, p. 99; see also Pettigrew, *op. cit.*, p. 85 and Budge, *op. cit.*, pp. 201-2.

39. Pettigrew, *op. cit.*, pp. 70, 101-2.

40. *Idem.*, pp. 69-71, 80—citing "Notice sur les Embaumemens des Anciens Egyptiens . . . ".

41. So Lucas, *op. cit.*, p. 243—citing *The Archaeol. Survey of Nubia, Bulletin* 2, Cairo (1908), pp. 9, 17 and *Bulletin* 1, p. 38, and *Report*,.pp. 205-12.

42. So Forbes, *Studies* . . . , pp. 98-99; but other modern analyists are inconclusive: A. Lucas, "The Use of Natron By The Egyptians In Mummification," *The Journal of Egyptian Archaeology*, Vol. 1 (1914), pp. 119-123; Schmidt, *op. cit.*, pp. 369-92; Paul Haas, "Note On The Inorganic Constituents of Two Egyptian Mummies," *The Chemical News*, Vol. XCIX (Dec., 1909), p. 296—but too early, also; cf. Pettigrew, *op. cit.*, p. 71, citing Rouyer's analysis.

43. Budge, *op. cit.*, pp. 212, 208 (bodies of the poor); see also A. B. Edwards, "Mummy," *Encyclopaedia Britannica* (1890), Vol. XVII, p. 158.

44. Budge, *op. cit.*, pp. 207, 208. See also Dawson, *op. cit.*, p. 954. J. E. Manchip White, *Ancient Egypt*, p. 109. G. Elliot Smith, "A Contribution To The Study of Mummification In Egypt," *Mémoires présentés à l' Institut Égypien* V, (1908), p. 5.

45. Pettigrew, *op. cit.*, p. 59—citing Belzoni, *Travels*, p. 170; p. 87—citing Dr. A. B. Granville's discovery of wax and bitumen in folds of peritonaeum of a mummy; p. 81—citing Dr. Verneuil that asphalt was used in preserving viscera; p. 82—citing Julia Fontenelle's work on mummy No. 708 of Passalaqua's Berlin Collection. "Embalming," *Encyclopaedia Britannica* (1890), Vol. VIII, p. 158.

46. Pettigrew, *op. cit.*, p. 60—citing catalogue notation of Passalaqua on the Berlin collection, p. 179; p. 74—on the mummy of Horseisi in the Museum of The Royal College of Surgeons; pp. 69-70, 80—citing Rouyer.

47. Edwards, *op. cit.*, p. 21; Pettigrew, *op. cit.*, p. 76 (2 lbs.); pp. 76-77—citing Rouelle; p. 77—citing Verneuil on Passalaqua's mummy No. 1556; Budge, *op. cit.*, p. 207; Lucas, *op. cit.*, p. 241—citing the Rhind Papyrus; p. 243—citing Wood Jones (. . . *Survey of Nubia*, Bulletin 1, p. 38 and Report, pp. 205, 212) and p. 243, citing G. E. Smith.

48. Pettigrew, *op. cit.*, p. 56.

49. *Idem.*, pp. 56 (citing Dr. Granville's mummy), 90 (Greco-Roman mummy of Cailliand), 93, 95, 98 (Greco-Roman specimen).

ration.[50] A number of bird, animal and reptilian mummies so prepared, however, have been found intact.[51]

Further support for the presence of bitumen as an element in the embalming process may be found in the use of ground-up mummies as a drug in later times. Traffic in this commodity flourished from at least the 12th century on, principally in Europe.[52] The supposed medical value of the drug (which seems to have been a universal curative!) rested in the bitumen contained in it.[53] This fact is made clear by the physican Ibn Beitar in the 13th century, when he identifies the drug as *mûmîya* (which went into Middle and Late Latin as *mumia*), "Bitumen of Judea," and "the mixture which the Byzantine Greeks used . . . for embalming."[54] This triple identification thus links, via the latter two cases, source and market once more.

We also note that Diodorus appears to know what he is talking about, if we are to judge from the details which he gives of a process which appears to have interested him. For example, in his discussion of embalming methods in general, he specifically asserts that the incision for evisceration was made in the left flank of the body, and that the heart was allowed to remain in the thorax.[55] Subsequent medical examinations of mummies have verified both points of specific detail on technique. Furthermore, most of the mummies said to have been prepared by a bitumen-connected method may be dated to the Graeco-Roman period[56]—the precise period of Diodorus, himself, and the period in which he should be expected to have been most capable of accurate reporting!

In conclusion, therefore, our examination of the evidence against the

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50. See Forbes, *Bitumen . . .*, p. 94, who suggests that bitumen was used in cheaper burials, hence the evidence may be simply lost.

51. Pettigrew, *op. cit.*, p. 129—citing Belzoni in reference to embalmed bull; p. 217—embalmed serpent; p. 182—citing hawk and ibis embalmings; Lucas, *op. cit.*, p. 242—citing Lortet and Gaillard, *La Faune Momifiée de l'Ancienne Égypt*, Vol. I (Lyon, 1905) and Vol. II (1909).

52. Budge, *op. cit.*, p. 202—Al-Magar prescribed it in the early 12th century; Smith, "Egyptian Mummies," *The Journal of Egyptian Archaeology*, Vol. 1, p. 195—noted by Thomas Brown in the 17th century; see also Pettigrew's chapter on the subject.

53. Dawson, "Mummy," *op. cit.*, p. 955; for the supposed medical values of bitumen—see Forbes, *Studies . . .*, pp. 94ff., 96-97, 98, 117; Budge, *op. cit.*, p. 209.

54. So Budge, *op. cit.*, pp. 201, 202, 208; see also Forbes, *op. cit.*, pp. 56, 99; but note the caution of Forbes, *Bitumen . . .*, p. 41, on the basis of the time element involved.

55. Dawson, "Making A Mummy," *op. cit.*, p. 42; Smith, "*A Contribution . . .*, *op. cit.*, pp. 16-17.

56. Pettigrew, *op. cit.*, pp. 90 (mummy with Greek initials on the wrappings), 98 ("Greco-Egyptian"); Budge, *op. cit.*, p. 206 but as an objection! Forbes, *op. cit.*, p. 41—where the bitumen process is specifically linked with this period; 56, 93 (bitumen "probably not used generally before the ptolemaic dynasty . . . "); *Studies . . .*, pp. 11, 98-99 (citing Coreman, *Chronique . . .*, No. 24); White, *op. cit.*, p. 109; Dawson, "Making A Mummy," *op. cit.*, p. 46; "Mummy," *op. cit.*, p. 954; Edwards, *op. cit.*, p. 21; Smith, *op. cit.*, p. 15; Lucas, *op. cit.*, p. 243 (citing G. E. Smith).

use of bitumen in Egyptian embalming, as an objection to the accuracy of Diodorus, has been shown to be without adequate basis. Instead, there are clear indications that bitumen *was* indeed used, not only in other Egyptian manufacturing, but specifically in embalming. Further, it has been shown that Diodorus was correct in regard to certain specific details of the embalming process, and hence there is the probability that he was also correct in regard to the ingredients of the process as well. Finally, it has been pointed out that Diodorus was contemporary with the very period in which bitumen appears to have become an embalming ingredient in general use.

Thus, the specific market of the Nabataean industry may be assigned to the embalming business of Egypt. This fact of market may then be joined with the monopolistic control by the Nabataeans of the Dead Sea bitumen industry to bring to its proper prominence the economic and political importance of the industry itself.

The Nabataeans emerge, therefore, not only as a group of caravaners and agriculturists, but also as the sole entrepreneurs of a basic industry in the economy of the eastern reaches of the Fertile Crescent. The Dead Sea was a primary source of pure bitumen, a necessary product in one of the most continuously flourishing businesses of Egypt.

The preeminence of this commercial enterprise may, in turn, explain a number of other phenomena connected with the political life of the area, hitherto ignored for lack of information. Thus the fierceness of the resistance of the Nabataeans to the attacks of Antigonus (312 B. C.),[57] culminating in the all-out defense of the Dead Sea in particular, is made more plausible when the full nature of the economic situation is realized. The mission of Syllaeus to Herod[58] may also be involved in this exploitation, since the lands of the Nabataeans and the Jews were contiguous, and the boundaries were frequently in dispute. The marked interest of Cleopatra in this area, aside from personal animosities, is also noteworthy here.[59] Her successful attempt to gain control of certain of the lands belonging to Herod and Aretas (perhaps specifically the lower Jordan Valley?), along with the amount of tax collected by Herod in her behalf,[60] are more reason-

57. Diodorus XIX, 95, 97, 100; see Forbes, *op. cit.*, pp. 29-30—where the suggestion is made that this was because of the importance of the industry to Egypt; Clapp, *op. cit.*, p. 901.

58. Josephus, *Antiq.*, XVI, xi; the problem of the border between Herod's kingdom and Nabatene at this period is a difficult one, and perhaps is involved in Syllaeus' visit.

59. Josephus, *Wars*, I, xiii; Forbes, *op. cit.*, p. 30.

60. The treaty reported by Josephus (*Wars* I, xiii and *Antiq.* XV, v) does *not* indicate that Herod controlled the Dead Sea area, rather, the relation to "Arabia" (i.e. Nabatene) is quite plain, and is reflected in subsequent events.

able in the light of the relative importance of the Dead Sea industry—together, perhaps, with the balsam groves near Jericho.[61] Possession of the sources of pitch (mineral and wood) meant a valuable source of income.[62] Control of both the Dead Sea bitumen and the Jericho balsam would thus have given Cleopatra a monopoly on raw materials basic, in a wide variety of ways, to the economy of her day. This could even have meant control of the dependent organizations.[63]

There thus lies in the report of Diodorus evidence for an important economic (and hence political) aspect of the Dead Sea which hitherto has not been emphasized. The relation of this to the role of the Nabataeans involved in the bitumen industry there thus enhances further their position and leadership in the commercial life of the ancient Near East, and may even suggest one of the reasons why they were there at all.

The Bodmer Papyri

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The Bodmer Papyri, reported to have been found in Upper Egypt, must be listed with the Dead Sea Scrolls among the most remarkable finds in archaeological history. They are a remarkable addition to the growing number of Biblical and Early Christian papyrus manuscripts. First to be published (in 1956) was *Papyrus Bodmer II*, a papyrus codex dated about 200 A.D.; it presented in remarkably well-preserved form the Greek text of John 1:1-14:26. Victor Martin edited this valuable manuscript.[1]

It is now possible to report three additional publications of the Bodmer collection. All three appeared in 1958. First of all, we note that Victor

61. Josephus, *Antiq.* XV, v and *Wars*, V, iv, v indicate the importance of the balsam groves and assert their value; Diodorus II, 48 and XIX, 98 assign them to the Nabataeans and reassert the value of the gums (for medical purposes); see also Strabo XVI. It is this writer's feeling that a case could be made for Nabataean control of the balsam groves, but in any event, all or part of the eastern shore of the Dead Sea, and possibly more of it, was in Nabataean hands; cf. *Antiq.*, XV, ix (even though Callirrohoe and Machaeras may have been controlled by Herod; cf. *Antiq.*, XIV, xxvii, XVII, viii and XVIII, v; *Wars* VII, xxv and, later, *Wars* III, ii and I, xxi); cf. also Jean Starcky, "The Nabataeans," *Biblical Archaeologist*, XVIII, pp. 97, 98-99.

62. The Nabataean's contribution ran to some 200 talents annually, but was only paid for one year, leaving Herod to answer to Cleopatra—an "ingratitude" greatly resented. Forbes, *Studies . . .*, pp. 17-18, 30, 52 suggests that this figure reflects the production rate at that time, and is a measure of the economic importance of the area as well.

63. Forbes, *op. cit.*, p. 51 (hence no competition for the market!), and pp. 17, 26 (the importance of the industry to Egypt, as an import).

1. See my article, "A New Papyrus of the Gospel of John," B.A., Vol. XX, pp. 54-63.

Martin published a *Supplement* to *Papyrus Bodmer II* (Bibliothèque Bodmer, Cologne-Genève). The 1956 publication covered 108 pages of manuscript and ended at John 14:26. The 1958 *Supplement* is much more fragmentary. It begins with page 109, of which parts of John 14:29-30 are preserved, and extends to page 154. Of pages 153 and 154 only the top portion has survived; it gives only the page number and, on page 153, a single Greek letter. The last bit of actual text, on page 152, gives portions of John 21:8-9. The editor wonders whether this manuscript originally contained Ch. 21 in the full form we know; he recalls that Codex Sinaiticus lacks vs. 25. If the chapter was copied in the full form familiar to us, the scribe must have crowded greatly the last three pages or else—most likely—he used other pages that have not survived. In any case, it seems clear that the original complete papyrus contained only the Gospel of John.

Papyrus Bodmer III, edited by Rodolphe Kasser, is a codex in Bohairic. Heretofore this Coptic dialect was not known in any document earlier than the ninth century (except perhaps the small Papyrus Michigan 926). This new Papyrus may be dated, according to the editor, in the fourth century, and gives a translation into Bohairic of an archaic Sahidic text (Sahidic is another Coptic dialect). The Editor of *Papyrus Bodmer III* has published his work in two parts; one gives the introductory information, four plates to show the handwriting, and the transcribed Bohairic text; the other gives the French translation of the Bohairic text (the two parts are Volumes 177 and 178 of the *Corpus Scriptorum Christianorum Orientalium*, Louvain).

The manuscript contains the Gospel of John and Genesis 1:1-4:2; since the last page is largely blank, the stopping at this verse in Genesis seems to have been deliberate. The pages that contained the early chapters of John are very poorly preserved, but from ch. 4:20 the text is very well preserved, though it is not copied as carefully as a skilled scribe would have done. One page, to judge by the quite different handwriting and page format, was written by another hand. This suggests that it was left blank by the person who wrote the rest of the manuscript. Curiously enough, this page included the verses just before and after John 7:53-8:11; the page is full as written by the later copyist and there is no room for the famous passage mentioned. Why the original copyist left this page blank is not clear; his handwriting, the Papyrus editor implies, is on the other side of the sheet, so the sheet cannot have been a later insertion; the original copyist evidently used as his model a manuscript which lacked John 7:53-8:11, for he left just the right amount of space for the omitted text and then began the next page. This is an intriguing mystery.

Papyrus Bodmer V, edited by Michel Testuz, gives the introduction, one plate, transcribed Greek text, and French translation of the *Nativité de*

Marie (Bibliothèque Bodmer, Cologne-Genève). This document is in a marvelous state of preservation; the complete text survives. The manuscript contains 56 (almost square) pages; *The Nativity of Mary* occupies 49 of them; the editor does not tell what is on the other seven pages.

This manuscript is dated by the editor in the third century A.D. Previously known manuscripts of *The Nativity of Mary*, except for a fragment of the fifth or sixth century, date from the ninth to the sixteenth centuries. The new manuscript requires an early date for the original writing of which this manuscript is a copy.

Actually the work is composite, as suggested by the double title in the opening words: *Genesis Marias Apokalypsis Jacob* (these Greek words mean: "The Birth of Mary, Apocalypse of James"). Scholars are generally agreed that the work includes four clearly defined sections:

1. Chs. 1-16 tell of Mary's parents, her birth, her first three years at home, her nine years spent in the Temple, her commitment to the care of Joseph, her conception of Jesus, and the clearing of Joseph and Mary from any suspicion of immorality. The first draft of this section the editor dates in the late second century.

2. Chs. 17-20 tell of the birth of Jesus in a cave near the road to Bethlehem. The main aim is to assert the perpetual virginity of Mary. She remained a virgin after the miraculous birth of Jesus. Joseph had sons by a marriage that preceded his taking Mary under his care; thus this document takes what later came to be called the Epiphanian view of the brothers of Jesus. These chapters, the editor thinks, combined various materials; this was done early in the third century.

3. Chs. 21-24 center interest on Zacharias, the father of John the Baptist. Herod is said to have sought John to kill him, to keep him from becoming king of the Jews; Elizabeth had taken John to the mountains, where he had been miraculously concealed; Zacharias, thought of apparently as high priest and identified with the Zacharias of Matt. 23:35, Luke 11:51, was killed in the Temple by Herod's men, and Simeon (Luke 2:25-32) was elected by the priests to succeed him. The editor dates the first draft of this section in the late second century. A notable feature of the story is the indication that Herod considered the child John (the Baptist) to be the Messianic child (compare the Messiah of Aaron in the Dead Sea Scrolls; John was of priestly descent).

4. Ch. 25 is a declaration, written in the first person, that James is the author of this work. It would seem that this (unconvincing) claim refers to James the son of Joseph, called brother of Jesus in Mark 6:3. The editor thinks that this brief chapter was at first the conclusion to the story of chs. 1-16, and when the three originally independent sources (chs. 1-16, 17-20, 21-24) were combined, it became the conclusion of the whole work.

How does the content of this manuscript compare with that of the previously known medieval manuscripts of this apocryphal story? It is essentially the same story. However, in the second division of the story, this manuscript lacks the speech of Joseph, his dialogue with the midwife, and the prayer of Salome; and from ch. 20 on, this manuscript is somewhat briefer, due to lack of some details found in the medieval manuscripts.

The so-called *Nativity of Mary* was widely popular in the Eastern churches. The editor reports translation into Syriac, Coptic, Arabic, Aramaic, and Ethiopian, and notes traces in Slavic tongues. But the work was never accepted in the West; no Latin translation is known, and Innocent I condemned the work in A.D. 417. Greek manuscripts and Eastern versions, however, show how early such fanciful apocryphal material attained written form and how widely it found acceptance.

FLOYD V. FILSON

Correction

In *B.A.*, Vol. XXI, No. 4 (Dec., 1958) Professor Malamat desires to confess to an inadvertent error, which neither he nor the Editors noticed in time. On page 98, lines 11-12: the King of Babylon should be Kadshman-Enlil I (not Kadashmanharbe); and he asked for the hand of the daughter of Pharaoh Amenhotep (Amenophis) III (not of Akhenaton).